TORSIONAL BEHAVIOUR ON BETHAMCHERLA MARBLE STONE AGGREGATE

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ABSTRACT

Concrete plays the most prominent role in the structural construction works, it is the most widely used as a construction material throughout the world. Based on the global usage, concrete is placed at second position over water. It plays a very significant role in the shaping our environment and sustainability of the construction industry. Ever since its discovery has become indispensable in construction practices, owing to its durable, reliable and workable properties. The name concrete is derived from the Latin term “concretes” meaning ‘grows together’ hinting at the chemical hydration process that causes the material inside to grow together from a visco-elastic state into a hard, dense and durable product. There are numerous plans of solid, which give differing properties, and cement is the most-utilized man-made item on the planet. Meanwhile we are not allowed to complete the natural resource usage in concrete. We have some waste materials which were not useful in that pattern of works.

One of those materials is Bethamcherla marble stone aggregates as replacement of coarse aggregate in concrete.This paper represents the study of tension strength of concrete for different combinations. The comparison is made between conventional aggregate specimen and specimens made with Bethamcherla marble stone aggregates (BMSA). The specimens of varying proportions are casted replacing partially and totally natural granite coarse aggregate (NGCA) with using BMSA. The specimens are tested by adding GI steel fibre of volume 0%, 1% and 2% of volume of conventional specimen. It is observed that there is consistent decrease of torsional strength of concrete of 0, 25, 50, 75 and 100 % of replacement of natural granite coarse aggregate (NGCA) with Bethamcherla marble stone aggregates. It was also observed that strength increased (volume) when 1% and 2% of GI steel fibers were used compared with conventional specimen.

Key-Words: Natural Granite coarse Aggregate(NGCA), Bethamcherla marble stone aggregate(BMSA),GI steel fibers, Torsional, concrete.

I. INTRODUCTION

The global use of concrete is next to water in this era. As the demand for concrete as construction material increases, the demand and scarcity has been raised to a peak.

Concrete might be made out of cement, aggregate (generally a coarse aggregate made of gravels or crushed rocks such as limestone, or granite, plus a fine aggregate such as sand), water, and/or admixtures (if required). Among the three quantities, aggregate possesses major part in the concrete mix. So, the aggregate content ought to be in a type of consisting good strength. The aggregate is differentiated as fine aggregate and coarse aggregate. The proportionate amount of every material (i.e. Cement, water and aggregates)
Influences the properties of hardened concrete. Based on the purpose and utilize, the properties of concrete can also be changed.

- The usage of concrete is expanding at a higher rate because of development in infrastructure and construction industry all around the globe.
- However, there are some negative effects of more creation of concrete like persistent, extensive extraction of aggregate from natural resources will prompt to its exhaustion and ecological imbalance.
- Researchers are looking for replacing coarse aggregate to make concrete more affordable and to lead maintainable development.

In the recent years, the growth in industrial production and the consequent increase in consumption have lead to fast decline in available natural resources on the other hand, a high volume of production has generated a considerable amount of course material which have adverse impact on the environment. The Civil Engineering construction industry is to be one of the most potential consumers of mineral recourses, thus generating a great amount of solid waste as a bye product stones. Stones have perhaps the noblest material from nature used by men for his artistic expression. In the concrete industry, generally used coarse aggregate is obtained from granite rocks, but in locations where there is no availability of granite rocks and also in the places where, there is a disposal problem of Bethamcherla marble waste, in such situations, the usage of BMSA is an advantageous consideration.

Bethamcherla marble is abundantly available, occupying about 10% of the earth’s surface in different forms. The main constituent of Bethamcherla is calcium carbonate along with silica and iron as impurities .Many grades of limestone are available and their classification is done on the basis of calcium carbonate content. The marble rock is metamorphic from the lime stone. In this research work the performance of discarded flooring Bethamcherla limestone from the town of Bethamcherla, located in the Kurnool district of Andhra Pradesh is considered. This occurs in the naturally cleft slab like elements which on polishing and processing into regular shapes that would make an excellent strength of flooring stone that has the luster and finish on par with its granite counterpart. Bethamcherla waste stone is one of the natural mineral having specific gravity ranging from 2.6 to 2.85. Bethamcherla marble stones are fundamental flaggy lime stone with natural split. It is very excellent flooring stone, which have been unique geo mechanical properties required for flooring stones.

AIM AND SCOPE OF THE STUDY

Main aim of the study is to know the involvement of Bethamcherla waste stone in construction works. In this study importantly, it is concentrated on some basic properties Bethamcherla waste stone, to know the suitability of the Bethamcherla waste stone in construction works by conducting some workability tests and some mechanical properties tests, in this paper we worked with compressive strength. To make explore the usage of local accessible materials to the surrounding people.

SCOPE OF THE EXPERIMENTAL WORK

In this experimental work, concrete incorporating Bethamcherla marble stone waste as replacement coarse aggregate and with and without G.I steel fibres,

The torsional strength characteristics are studied, by casting the beam specimens of size 150x150x1200mm.

II. LITERATURE REVIEW

TORSION BEHAVIOUR OF BEAM WITH BAMBOO AS REINFORCEMENT AND COCONUT SHELL AS AGGREGATE

Kesani Sarath Chandra gowd, D. Arul Prakash

- The behaviour of both conventional and coconut shell concrete before cracking was elastic.
- Cracks were formed and propagated at nearly 450 with the horizontal which is useful in deciding the loading as purely torsional.
- The ultimate load carrying capacity of the conventional concrete and coconut shell concrete with steel reinforcement was about 12.5T.
- The ultimate load carrying capacity of the coconut shell concrete with un-treated bamboo and treated bamboo is 10.5T and 11T respectively.

EXPERIMENTAL STUDY ON THE TORSIONAL BEHAVIOUR OF RECYCLED AGGREGATE CONCRETE BEAMS

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- Torsional strength decreases with increase the percentage of replacement of natural aggregate with recycled aggregate . It was found that up to 50 % replacement of aggregates the Torsional strength reduction is less and not even 10 %. Therefore the usage of recycled aggregates up to 50 % can be acceptable.
- Twist at failure decreases with increase the percentage of replacement of natural aggregate with recycled aggregate..
- All the beam specimens were tested under pure torsion, measuring the twist for each and every increment of torque. The ultimate torque and twist at failure .
- To understand the torsional behavior of concrete beams the torque and twist graphs were drawn.

It was observed that the torsional strength decreases with increase the percentage of replacement of natural aggregate with recycled aggregate. For 50% replacement, the strength reduction is up to 8.51 % and for 100% replacement, the strength reduction is up to 17.02 %. Fig 5 shows the variation of torsional strength with percentage of replacement of recycled aggregate.

III. MATERIALS AND PROPERTIES

Cement: Cement is the most important material in the concrete and it act as the binding material. Ordinary Portland cement of 53 grade was used.

Aggregate: The basic objective in proportioning any concrete is to incorporate the maximum amount of aggregate and minimum amount of water into the mix, and thereby reducing the cementitous material quantity, and to reduce the consequent volume change of the concrete.

Coarse aggregate:

The fractions from 20 mm are used as coarse aggregate. The Coarse Aggregates from Crushed Basalt rock, conforming to IS: 383 is being used.

Bethamcherla Marble Aggregate:
The stone itself, specifically in the forms of overburden, screening residual, stone fragments. Stone wastes are generated as a waste during the process of cutting and polishing. It is estimated that 175 million tons of quarrying waste are produced each year, and although a portion of this waste may be utilized on-site, such as for excavation pit refill or berm construction, the disposals of these waste materials acquire large land areas and remain scattered all around, spoiling the aesthetic of the entire region. In this project we crushed BMSA into required sizes i.e., 20mm .

Fine aggregate:
The amount of fine aggregate usage is very important in concrete. This will help in filling the voids present between coarse aggregate and they mix with cementitous materials and form a paste to coat aggregate particles and that affect the compact ability of the mix. The aggregates used in this research are without impurities like clay, shale and organic matters. It is passing through 4.75mm sieve.

IV EXPERIMENTAL INVESTIGATION

When torsion is applied to a structural member, its cross section may warp in addition to twisting. Torsion in beams arises generally from the action of shear loads whose points of application do not coincide with the shear centre of the beam section. The test results of torsion and angle of twist with and without Fibre are discussed as in the upcoming section.

Test on Compressive strength

The torsion test is conducted with the replacement of NGCA aggregate by BMSA in concrete by 0, 25, 50, 75, and 100% along with addition of G.I steel fibres in 0%, 1% and 2% of the volume of the concrete. Beams are cast with these replacement proportions and galvanized iron steel fibres are added as at the time of mixing. The beams tested for torsion at the age of 28 days. The details of test results of torsion tests are illustrated as the following Table

Test results and discussion for torsion at the age of 28 days

The results of ultimate torque made with NGCA and BMSA for twenty eight days with 0,1,2% of G.I Steel fibres are presented in the table 6.6. From this it is observed that as a replacement of BMSA increases, the ultimate torque decreases continuously.

For NGCA-0-0 the ultimate torque reported as 5789KN-mm and for BMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0, The ultimate torque are 5528, 5345, 5012 and 4788 KN-mm respectively. Percentage decrease of ultimate torque with respect to NGCA-0-0 are 4.51, 7.67, 13.42 and 17.29 for BMSA-25-0, BMSA-50-0, BMSA-75-0 and BMSA-100-0 respectively.

For NGCA-0-1 the ultimate torque reported as 5842 KN-mm and for BMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1, The ultimate torque are 5500, 5298, 5115 and 4893 KN-mm respectively. Percentage decrease of ultimate torque with respect to NGCA-0-1 are 5.85, 9.31, 12.44 and 16.24 for BMSA-25-1, BMSA-50-1, BMSA-75-1 and BMSA-100-1 respectively.

For NGCA-0-2 the ultimate torque reported as 5915 KN-mm and for BMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2, The ultimate torque are 5645, 5408, 5218 and 4987 KN-mm respectively. Percentage decrease of ultimate torque with respect to NGCA-0-2 are 4.56, 8.57, 11.78 and 15.69 for BMSA-25-2, BMSA-50-2, BMSA-75-2 and BMSA-100-2 respectively.

Effect of G.I steel fibres for torsion at the age of 28 days

The percentage increase in ultimate torque for NGCA-0-1 and NGCA-0-2 is 0.91 and 2.18 over NGCA-0-0 mix. Similarly percentage increase for BMSA-25-1 and BMSA-25-2 mix is -0.51 and 2.12. The same trend continued for all other mixes. There is a percentage increase in ultimate torque for BMSA-50-1 and BMSA-50-2 mix is-0.88 and 1.18. Percentage increase in ultimate torque for BMSA-75-1 and BMSA-75-2 mix is 2.05 and 4.11. Percentage increase in ultimate torque for BMSA-100-1 and BMSA-100-2 mix is 2.19 and 4.16.

CASTING OF SPECIMENS

Before placing the concrete inside faces of the mould are coated with the machine oil for easy removal afterwards after completion of the workability tests, the concrete has been placed in the standard metallic moulds in three layers and has been compacted each time by tamping rod. Before placing the concrete inside faces of the mould are coated with the machine oil for easy removal afterwards. The concrete in the moulds has been finished smoothly.

CURING
After casting the specimen, the moulds were air dried for one day and then the specimens were removed from the moulds after 24 hours of casting of concrete specimens. Markings have been done to identify the different percentages. All the specimens were cured in curing tank (water curing).

V. TEST RESULTS

Table: Ultimate torque and maximum angle of twist

S.NO	Nomenclature of the specimen	Ultimate torque (kN-mm)	Maximum deflection ($mm \times 10^{-2}$)	Maximum angle of twist $\times 10^{-4}$ rad/cm	% increase / decrease in angle of twist
1.	NGCA-0-0	5789	402	0.28	-
2.	BMSA-25-0	5528	393	0.27	-3.57
3.	BMSA-50-0	5345	365	0.25	-10.71
4.	BMSA-75-0	5012	341	0.23	-17.86
5.	BMSA-100-0	4788	327	0.22	-21.43
6.	NGCA-0-1	5842	419	0.29	+3.57
7.	BMSA-25-1	5500	389	0.27	-3.57
8.	BMSA-50-1	5298	377	0.26	-7.14
9.	BMSA-75-1	5115	359	0.25	-10.71
10.	BMSA-100-1	4893	347	0.24	-14.28
11.	NGCA-0-2	5915	436	0.30	+6.67
12.	BMSA-25-2	5645	410	0.28	0.00
13.	BMSA-50-2	5408	396	0.27	-3.57
14.	BMSA-75-2	5218	383	0.26	-7.14
15.	BMSA-100-2	4987	364	0.25	-10.71

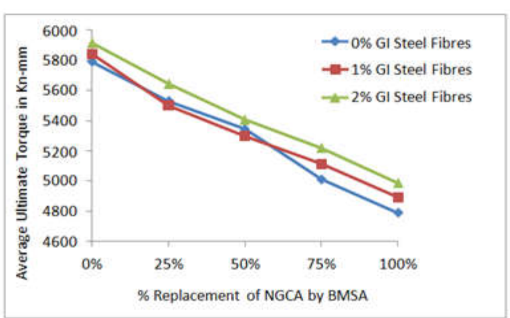

Figure: 28 days average Ultimate torque Vs % replacement of NGCA by BMSA at 0%, 1% and 2% GI Steel Fibres

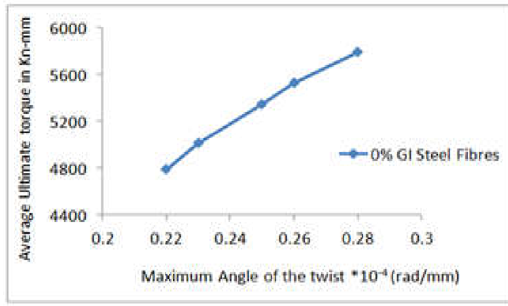

Figure: 28 days average Ultimate Torque Vs average angle of the twist at 0% GI Steel Fibres

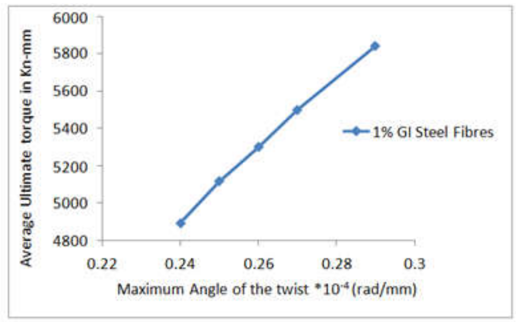

Figure: 28 days average Ultimate Torque Vs average angle of the twist at 1% GI Steel Fibres

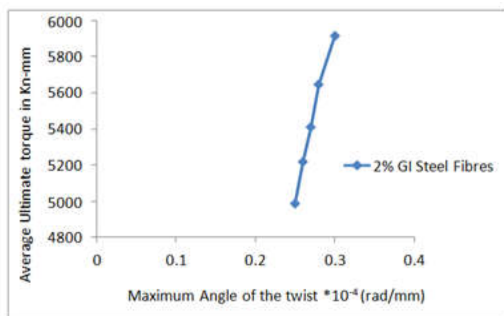

Figure: 28 days average Ultimate Torque Vs average angle of the twist at 2% GI Steel Fibres

Maximum deflection Vs Maximum Angle of Twist

All the beams exhibited linear torque rotation behavior at initial state. The toque rotation relationship of beams with Fibres showed considerable improvement compared to conventionally reinforced beams. The below Figures shows the graphical representation between the Maximum angle of twist and maximum deflection for with Fibres(0%,1%,2%) and without Fibre(0%).

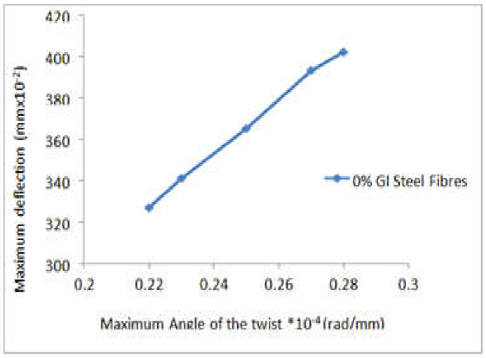

Figure. Maximum deflection Vs maximum Angle of Twist at 0% GI Steel fibres

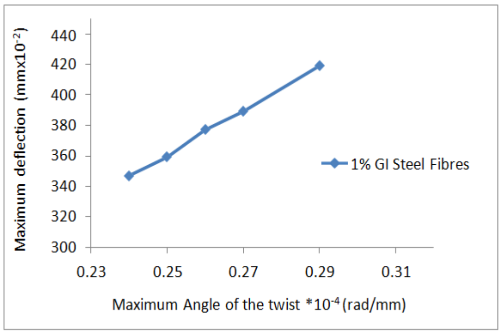

Figure. Maximum deflection Vs maximum Angle of Twist at 1% GI Steel fibres

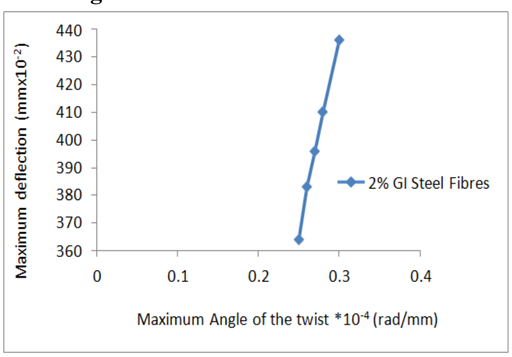

Figure. Maximum deflection Vs maximum Angle of Twist at 2% GI Steel fibres

VI. CONCLUSIONS

1. The ultimate torque decreases with increase in replacement with BMSA and increase with increase in G.I steel fibre content in concrete.

- For NGCA-0-0 the ultimate torque reported as 5789KN-mm for 28 days respectively
- For NGCA-0-1 the ultimate torque reported as 5842KN-mm for 28 days respectively
- For NGCA-0-2 the ultimate torque reported as 5915KN-mm for 28 days respectively

REFERENCES

- Adrian K. Y. and dRiadh Al-Mahaidi. "Experimental investigation on torsional behaviour of solid Box-section re beams strengthened with cfrp using photogrammetry, journal of Composites for Construction. Vol. 10, No.4. August 1. 2006 page No.321-329.
- Adrian K. Y. Hii and A I-Mahaidi,- Torsional capacity of CFR, strengthened reinforced concrete beams- Journal of Composites for Construction, Vol. I No. 1, February 1, 2007.page No.71-80.
- Almeida .Recycling of stone slurry in industrial activities: Application to concrete mixtures. Building and Environment vol42. 2007. pp.810-819.
- Alwis.W. A. M. And Mohammad A. Mansur, M. Aroc"Torsional Strength of Tic Scams Containing Rectangular Openings "Journal of structural Engineering, Vol. 113, No. November 1987, Page No2 1990.
- Baboo Rai, "influence of marble powder/granular in concrete mix", International journal of civil and structural engineering. Vol., No-4. 201 l, pp-827-834.6
- Bahar Demirel. "The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete... Internal journal of physical sciences 2010-vol.519, pp.1372-380.
- Bern Jacobsen. Erik Hjonh-Hansen. And Ivar Holamd." Cyclic torsion tests of concrete box columns, art of the journal of the structural engineering, vol-110, No.4, April-1984.page no.803-822.8.
- Celebi. M., E. Samarkand N. Youssef. Members “Torsion Response of unique Building". Journal of structural Engineering. Vol. 117. No. 5, May.1991. PageNo.25846.